SCIENCE.

FRIDAY, JULY 17, 1885.

COMMENT AND CRITICISM.

An appropriation of fifty thousand dollars was granted by the legislature of Pennsylvania, at its late session, to continue the state geological survey for 1885 and 1886, and the governor has signed the bill. The board of commissioners of the survey asked for ninety-two thousand dollars, to which the senate agreed; but it was reduced by the house to the above sum. It will be expended chiefly on the anthracite regions. A final report by Prof. J. P. Lesley will close the series of reports, giving, in a condensed form, a summary of the whole, — a most difficult but exceedingly useful and popular volume.

The legislature made short work of the difficult and troublesome question of how the large accumulation of printed reports of the survey shall be disposed of, by voting the books to themselves. They reduced the number to be hereafter printed, and disposed of them in practically the same way; reserving, however, a sufficient number for distribution to public libraries, colleges, and for exchange with other states and countries. The system of selling the reports has been abolished, as the large number of gratuitous copies interfered with the sales. The large number of small volumes of these reports, and the manner in which they will be scattered broadcast through the state, will soon render it difficult to collect a perfect set; but the great size of the edition will always make them cheap.

The faith of the earlier geologists, that the whole earth was built according to the European pattern, has received in other parts of the world many severe contradictions, of which our country has furnished a good share. Years ago, the thousands of feet of Appalachian sediments, and the undisturbed position of the typical New-York series, ran counter to beliefs prevalent at that time in England and on the continent; and later explorations have continued the process of broadening our geological understanding by bringing to light one example after another of structures and occurrences that violate the European precedents. The 'great break' between paleozoic and mesozoic formations is passed over quietly in the Rocky-Mountain region by a mighty series of strata following conformably from Cambrian to cretaceous. The Laramie controversy began, in good part, in the belief that the deposits in question must be either cretaceous or tertiary, and could not be neither or both. And in paleontology our many-toed horses, if the diminutive quadrupeds deserve that name, and the sharp-toothed birds, if those strange-winged creatures may be so called, confirm the change from Cuvier's teachings to Darwin's.

In structural geology the contradictions are as marked. The old dispute concerning craters of elevation has new and unexpected light thrown on it in the local upheavals of the Henry Mountains, where lateral intrusions of lava blister up the overlying strata. At a time when the theory of direct vertical elevation by underlift was going out of fashion in some quarters, the enormous upheaval discovered in the horizontal rocks of the Colorado plateaus restored it to a firmer place than it ever had. The theory of the ice-cap, or, in other words, the idea that areas of glaciation were limited southward by latitude lines, found its first serious check in the absence of every thing but local ice-action among our Cordilleras, due west of a much lower region that had been heavily glaciated. The attitude of faults that is 'normal' in some countries is directly abnor-

mal in others, and the name is an unhappy misnomer.

Finally, the rule stated in the latest English text-book of geology, that faults give rise to little or no topographic feature, so that their existence would commonly not be suspected, is conspicuously violated in the northern part of the Great Basin, over an area about as large as England. In this region, as well as in others of similar structure farther south, the faults break through all formations, including the recent; and the heaved masses stand up, bordered by abrupt cliffs that have not retreated perceptibly from the line of fracture. The depressions among the tilted blocks are occupied by numerous lakes, which are thus, in respect to origin, as novel as the distinct forms of the faults themselves; for, among the thousands of lakes in other parts of the world, it is difficult to name half a dozen examples whose origin is so directly due to this kind of displacement.

VISITORS TO SWITZERLAND in the last twenty years have seen one characteristic part of that charming country at a disadvantage. The glaciers that the guides or their fathers remember seeing well advanced into the valleys have been found greatly reduced in size, shrinking back a thousand feet or more from their fresh-looking moraines, and uncovering broad surfaces of bare rock and gray rubbish, not attractive to the general visitor, however interesting they may be for the glacialist. The little huts built a few years ago at the foot of the ice, for the reception of tourists, have been left quite out of place, as the ice melted away uphill behind them. Now the good news arrives that a good number of glaciers have come to a halt in their retreat, and that for two or three years an advance has been observed. This is well for our children, who may now see the glaciers in good size again in ten or twenty years, if the advance is as persistent as the retreat that preceded it.

LETTERS TO THE EDITOR.

The sculptures of Cozumalhuapa.

THE suggestion in *Science* (vol. v. p. 524) that the shell-carvings figured by Mr. Holmes in the last report of the bureau of ethnology may indicate a common origin with those of Cozumalhuapa, will naturally lead to the inquiry, What branch of the American race executed the latter?

Unfortunately this is not easily answered. Perhaps we may proceed most safely by the method of exclusion. When Cozumal was discovered, three entirely dissimilar stocks occupied the immediate vicinity. The locality itself was held by the Cakchiquels. According to their annals, as preserved by the native chronicler, Francisco Ernantez Arana Xahila, they had occupied that territory but shortly before the Spanish conquest, driving out either the Xincas or the Pipiles, both of whom continued to live at no great distance. The Pipiles were a Nahuatl-speaking colony, of the same blood and language as the Aztecs, and were skilled in the same arts. The Xincas, on the contrary, were a savage people, whose culture-words were borrowed from either the Pipil or the Cakchiquel tongues. They may therefore be excluded.

The Cakchiquels were one of four tribes closely allied in language, culture, government, and geographical position; the others being the Quiches, the Tzutuhils, and the Akahals. They were familiar with picture-writing, stone-cutting, the metallurgy of gold, silver, and copper; erected massive buildings of stone and mortar; and were adepts in carving designs and weaving cloth. They certainly had the technical ability to execute such work as that on the slabs of Cozumal; but what is lacking, is evidence that it is in the style of their art. It differs very widely from that of Palenque and Copan.

The deficiency here pointed out is one most desirable to have filled. The vicinity of Iximche and Gumarcaah, the ancient capitals of the Cakchiquel and Quiche nations, might still yield a harvest to the persevering archeologist, in spite of the reports of Mr. Stephens. The Archbishop Garcia Pelaez, writing in 1850, stated that the government of Guatemala had 'recently' caused a careful survey, with maps and drawings, to be made of these remains (*Memorias para la Historia de Guatemala*, tom. i. p. 15); but I cannot learn that these were ever published, nor have my correspondents in Guatemala been able to ascertain the whereabouts of the originals. I may also add, that I have endeavored in vain to find out what became of the manuscripts left by Dr. Habel, the discoverer of the remains at Cozumal. Many of his notes had not been published, and it is quite possible that they would throw further light on this interesting question. D. G. BRINTON.

Media, Penn., July 2.

The geology of natural gas.

Prof. I. C. White's article on the geology of natural gas (*Science*, June 26) must necessarily attract no little attention from those who have never been in the oil and gas regions of south-western New York, western Pennsylvania, and eastern Ohio, where these wonderful and natural products are obtained; and also from those who are familiar with its commercial value and usefulness, but who have never made a study of the geological phenomena connected with its occurrence. In fact, the geology of this interesting region is so imperfectly understood by some of our leading professional geologists, who have never had

an opportunity to investigate in the field all the geological conditions under which petroleum and natural gas are found, that I fear Professor White's necessarily brief article, based upon his field studies, will mislead many.

Although it is to be regretted that no general work "has been published on the subject which would prove of any value to those engaged in prospecting for natural gas," yet Mr. John F. Carll, geologist in charge of the survey of the oil regions, and myself, among others, have collected a vast amount of information on the subject to elucidate many of the intricate questions connected with the exploration of natural gas.

Professor White's theory, that 'all great gas-wells are found on the anticlinal axes,' cannot be accepted until he shall limit, by definition, all great gas-wells to exclude all gas-wells, both large and small, comparatively, which produce gas from strata not found either on anticlinal axes or in close proximity to such structural lines. The Kane gas-wells, the Ridgeway well, the 'Old Mullin snorter,' and several Bolivar wells, are notable instances among many which might be mentioned where large gas-wells have been drilled in or near the centre of synclines.

Although it is a fact that many of our largest Pennsylvania gas-wells are located near anticlinal axes, yet the position in which gas may be found, and the amount to be obtained, depend upon (*a*) the porosity and homogeneousness of the sandstone which serves as a reservoir to hold the gas; (*b*) the extent to which the strata above or below the gas-sand are cracked; (*c*) the dip of the gas-sand, and the position of the anticlines and synclines; (*d*) the relative proportions of water, oil, and gas contained in the sand; and (*e*) the pressure under which the gas exists before being tapped by wells.

All oil-bearing sandstones contain a greater or less quantity of gas; and most gas-producing sandstones contain some oil, although a number of wells said to produce 'dry gas,' or that in which no oil or water can be detected, contain gas to the exclusion of fresh water, salt water, or oil.

Many facts could be cited which would disprove or render insufficient Professor White's 'three or four general rules' connected with the occurrence of natural gas in Pennsylvania formulated on the basis of his theory. This theory, in many cases, apparently explains the occurrence of gas; and what have proved large gas-wells have been located on anticlinals; but the theory, as a practical basis of successful operations generally, has no more claims as a final statement than 'Angell's belt theory,' which accounted for the occurrence of petroleum, as understood by him in 1867, when his theory was first announced. Many successful oil operations have been based on the 'belt theory,' and fortunes made; but it has long since been found to be insufficient to account for the existence of petroleum in all the Pennsylvania districts.

CHAS. A. ASHBURNER,
Assistant geologist Penn. surv.
907 Walnut Street, Philadelphia,
July 1.

In reply to Mr. Ashburner's criticism of the views advanced in my article on natural gas, I would say that the necessary brevity of the paper in question prevented the mention of many facts that might have rendered the conclusions clearer, and less open to challenge. One of these is, that my communication had especial reference to the natural-gas regions proper; i.e., where the gas is unconnected with oil-fields. Most geologists know that natural gas in large quantity exists with, and contiguous to, every oil-pool, apparently as a by-product in the generation of the oil; and of course the rocks are filled with it wherever it can find a reservoir. To gas-wells from such sources Mr. Ashburner's criticism may sometimes be found applicable; but, even with these, by far the larger ones will be found on the arches of the rocks.

The cases that Mr. Ashburner mentions, where large gas-wells have been found at the centre of synclines, do not necessarily contradict my conclusions; for no one knows better than he that a subordinate crumple or anticlinal roll often runs along the central line of a syncline. Messrs. Ashburner and Carll have indeed collected and published many well records, and other data concerning oil and gas, that are invaluable with reference to the contiguous oil and gas regions already developed; but, if they have written any thing that would prove a guide to one in search of new gas-fields, the writer has failed to get access to the same.

My excuse for writing the article on natural gas was that I might be of some service in preventing the waste of capital that has been going on within a radius of fifty miles from Pittsburgh by an indiscriminate search for natural gas; and it is a sufficient answer to Mr. Ashburner's criticism to point him to the brilliant lights along the crests of the Waynesburg, Pin-Hook, Washington, Bull-Creek, Brady's-Bend, Hickory, Wellsburg, Raccoon, and other anticlinals, and also to the darkness that envelops the intervening synclines, in which hundreds of thousands of dollars have been invested without developing a single profitable gas-well. The same result has been proven in other portions of the country. The Great Kanawha valley above Charleston has been honeycombed with borings for salt, and the only gas-wells developed were found within a belt a few rods wide, which coincides with the crest of the Brownstown anticlinal, where immense flows were struck. In this connection, I should state that Col. Allen of Charleston says he can trace the Brownstown anticlinal by the escaping gas across streams, and even mountains, from the Kanawha River to the Big Sandy, where, on its crest, near Warfield, two of the largest gas-wells ever known have recently been struck. At Burning Springs, on the Little Kanawha, the only large gas-wells were found on the very crest of the great uplift in that region. The gas-belt of western Ohio, through Findlay and other towns, follows closely the line of the Cincinnati arch; and the same story is repeated in other localities too numerous to mention.

Mr. Ashburner can, if he chooses, interpret these facts as mere coincidences, and explain them to himself as having no more bearing on the question of finding gas than 'Angell's belt theory' of oil; but the practical gas-operator can no longer be deluded by such logic into risking his money in water-holes (synclines) where so many thousands have been hopelessly squandered.

With regard to the anticlinal theory not being 'a practical basis for successful operations,' I deem it a sufficient reply to state that all the successful gas companies of western Pennsylvania and West Virginia are getting their gas from the crests of anticlinal axes, while those that have confined their operations to synclines have met with uniform financial disaster.

The statement was distinctly made in my original communication, that gas would not be found on all anticlinals, nor at all localities along one that actually

produces gas, since other factors have to be considered, as there stated; but, with the facts before us, it would certainly prove a great saving of capital in the search for gas, if operations were confined to the crests of the anticlinals; and I fail to perceive how Mr. Ashburner's fears for the 'misleading' character of my article can be realized. I. C. WHITE.

Mountain-Lake Park, Md., July 11.

A rare dolphin.

On the 3d of June the national museum received from Messrs. Warren & Co., fish-dealers in Pensacola, Fla., a very beautiful and highly interesting dolphin, which was captured in the Gulf of Mexico. The upper surfaces of the body were dark slate-color, sprinkled with whitish spots about the size of a cent; while the under surfaces were white, spotted with dark gray. The species belongs to the genus Prodelphinus, — a genus closely allied to Delphinus, of which the dolphin of the ancients, D. delphis, is the type. Numerous species of Prodelphinus have been described from single skulls, but scarcely any thing is known regarding their external forms or relationships. The recent discovery of great schools of this spotted species in the Gulf of Mexico, and also, still more recently, by the U. S. fish-commission steamer Albatross, off the coast of North Carolina, gives the hope that we may soon be able to clear away the obscurity now resting upon the genus.

F. W. TRUE.

U. S. national museum.

The scenery of Arizona.

The unique character of western Arizona leads me to add a few words to the article of 'A. G.' in your issue of June 26. Only ignorance of the extreme attractiveness of this almost unexplored region explains the fact that so few tourists find their way thither.

My chief object in addressing you is to mention an easily made excursion from Flagstaff, fifty miles to the south, through Oak-Creek valley, and into the valley of Beaver Creek, to Fort Verde. Oak Creek is more like a White-Mountain stream than any other creek that I have seen in Arizona. The valley broadens to a considerable width, after dropping down a thousand feet or more from the mesa upon which the creek rises, and is enclosed by lofty bluffs of sandstone, the lower half of which is deep red, while the upper half is bright gray. The line of demarcation between these colors is remarkably distinct. These rocks, of mesozoic age, have been sculptured by eroding waters in the most wonderful manner.

This region is easily explored by following the trails on horseback. The rocks have not, of course, the sharpness and steepness of limestone mountains (the Alps, for instance); but it has never been my lot to view scenery elsewhere so graceful and picturesque. I feel at liberty to speak with enthusiasm on this subject, for none that visit Oak-Creek valley will come away disappointed. R. SPAULDING.

Montclair, N.J., July 4.

The classification and paleontology of the U. S. tertiary deposits.

Although much tempted to make some comments on the remarkable statements of Dr. Otto Meyer relative to the south-western tertiaries, in his late article in the *American journal of science*, I had determined to keep silence until the second part of his work, presumed to contain the stratigraphical evidence he might have to present, should have appeared. In view, however, of Heilprin's notice of the subject in the issue of *Science* of June 12, I desire to enter a *caveat* on both sides of the question, as one who has spent eighteen years, more or less, in the study of these formations. I emphatically agree with Heilprin as to the impossibility of subverting the cumulative stratigraphical evidence to the effect that the relative superposition of the several principal stages — the Burstone, Claiborne, Jackson, and Vicksburg groups — cannot be otherwise than as heretofore ascertained in hundreds of localities, by others as well as by myself; even supposing that the geographical distribution, with relation to the progressive elevation of the continent, could leave any doubt in the premises. I recall to mind that years ago I had occasion to repel a similar attempt, on the part of Mr. Conrad, to subvert the relative position of the Jackson and Vicksburg groups upon supposed paleontological evidence (see 'Remarks on the Shell Bluff group of Mr. Conrad,' in *American journal of science*, 1867). As Dr. Meyer seems to have been on the spot, and must have seen the Jackson strata disappearing beneath those of the Vicksburg group (if he ever descended Pearl River below Jackson), and the Claiborne and Jackson vanishing beneath the same and the Grand Gulf rocks (if he descended the Chickasawhay River), apart from what is proven by the exposures on the Tombigbee and Alabama rivers in the state of Alabama, his prediction that 'probably' the whole series might have to be turned upside down, is strongly suggestive of the periodic attempts to subvert the 'Copernican system' of astronomy.

Aside, however, from Dr. Meyer's stratigraphical vagary, I strongly sympathize with his views in respect to the transition of so-called species, mostly named by Conrad, from one of the stages to another; I repeatedly called Conrad's attention to the impossibility of maintaining a number of his distinctions, especially among the genera Pleurotoma, Fusus, Voluta, Corbula, Venericardia, and others; and finally, finding that every variation, clearly apparent to me as such, was by him interpreted as a new species, I ceased to send him fossils from the south-western formations, in order not to swell uselessly the already long list of spurious species. In a number of cases Dr. Meyer has observed and recorded precisely what I have long known to be the fact, — that oftentimes from two to five of Conrad's species are mere variations, easily recognized as such when the rich material is seen on the spot and in numerous localities. That Dr. Meyer has in all cases judged correctly, I am of course unprepared to say; but I emphatically hope that a critical revision of the tertiary and upper cretaceous fauna of the south-west will soon be made, with a view to what we have learned on the subject of evolution since Lea's and Conrad's time, and that the host of varieties now cumbering our tertiary check-lists in the guise of species will be reduced to something like a comprehensive view by a master hand. I doubt if there exists a finer opportunity for observing the evolution of marine species in tertiary times than is presented by the minutely differentiated formations of Mississippi and Louisiana.

E. W. HILGARD.

Berkeley, Cal., June 22.

The ginkgo-tree.

A large and remarkably fine specimen of Salisburia adiantifolia was in fruit on the Landreth estate, near Bristol, Penn., during September last, — an annual and by no means uncommon occurrence, according to the proprietors. WINTHROP E. STONE.

Mass. ag'l exp't station, July 6.

THE TYNDALL FELLOWSHIPS.

AT the close of Professor Tyndall's brilliant tour as a lecturer on physics in various cities of this country during the winter of 1872–73, he devoted with unparalleled generosity the net results of all that he had earned to the encouragement of studies in physical science among young Americans. The amount thus set apart was somewhat more than thirteen thousand dollars ($13,033.34), and it was given to three trustees, — Professor Henry of Washington; the founder's kinsman, Gen. Hector Tyndall of Philadelphia; and Dr. E. L. Youmans of New York. After the death of the first two named, President F. A. P. Barnard and Professor Lovering succeeded to the vacant places. In the deed of trust, which is dated Feb. 7, 1873, and may readily be found in the Smithsonian report for 1872 (p. 104), the giver declared his purpose to be the advancement of theoretic science, and the promotion of original research, especially in the department of physics. The method of employing the fund which he then proposed was to assist in supporting, at such European universities as they might consider most desirable, two American pupils who might evince decided talent in physics, and who might express a determination to devote their lives to this work. He added that it would be his desire to have each scholar spend four years at a German university, — three devoted to the acquisition of knowledge, and the fourth to original investigation.

For some reasons not publicly explained, and not difficult to conjecture, the trustees have been embarrassed in trying to carry out the precise wishes of Professor Tyndall; and consequently but a very small part of the income of his fund has been directed toward the assistance of young physicists. One of those who received encouragement from the fund generously returned to the trustees the sum advanced to him; another to whom the benefit of the scholarship was offered hesitated about pledging himself to remain four years in Europe, and declined the honor of an appointment. Meanwhile the opportunities for studying physics in this country have rapidly improved. Excellent investigators in several universities have been provided with admirable laboratories, and with all the requisite apparatus for research. It is true that the opportunity to go abroad for a brief sojourn is still highly prized by our young men; but, if associated with an implied obligation to remain in Germany during four years, the value of the opportunity is seriously impaired. Meanwhile the trustees have been careful in the management of their fund, and, having added the unexpended income to the principal, are able to report that the original thirteen thousand dollars have grown to thirty-two thousand dollars, — a remarkable record in these days of financial shrinkage.

Fortunately the donor of the fund is still living, and has been able to modify the original conditions of his gift. At the recent commencement of Harvard college, President Eliot announced that Professor Tyndall gave to Harvard one-third of the accumulated fund, another third to Columbia college, and the remainder to the University of Pennsylvania. The income is to be devoted to the maintenance by each institution of a graduate scholarship or fellowship in the department of physics.

Under these new conditions, the original purpose of this generous gift is sure to be accomplished. By the maintenance of a wise system of appointments, such as the experience of these three colleges will certainly devise, the hope of winning a Tyndall prize will prove a strong incentive to young American physicists. The foundation will have an influence upon scientific studies akin to that exerted upon classical studies for many generations by the prizes of Bishop Berkeley. It is also interesting to remember, that, as the name of Rumford, an American physicist, is associated indissolubly with the Royal institution of Great Britain, where Tyndall holds the commanding station, so the name of an English physicist, Tyndall, will always be remembered with gratitude in the land of Rumford's birth, for kindred generosity in the encouragement of kindred pursuits.

THE LATEST VOLCANIC ERUPTION IN THE UNITED STATES.

In one of the volumes of the Proceedings of the California academy of sciences, Dr. H. W. Harkness describes the cinder-cone and lava-field at Feather Lake, Plumas county, Cal. Writing as I do in the field, and without access to books, I am unable to cite more accurately the description referred to. Dr. Harkness speaks of this volcano as being extremely recent, and mentions the fact that trees killed and half burned by the lava were still standing. Mr. John B. Trask also refers to it, with the statement that the eruption occurred in January, 1850; but he does not, so far as I recall, state the source of his information. I regret that I am obliged to depend upon memory alone in referring to these accounts of the outbreak. Within the last week I have had the pleasure of visiting Feather Lake in company with Mr. J. S. Diller, and can fully confirm Dr. Harkness's account of it, and feel confident that Trask's date, January, 1850, is quite in harmony with all appearances.

Feather Lake, prior to the eruption, was a sheet of water about four or five miles long, lying ten miles east-north-east of Lassen's Peak, say, in latitude 40° 34′, and longitude 121° 19′; and its altitude is about 5,800 feet above the sea. The vent now covered by a large cinder-cone is situated a little above the western shore. From it there flowed a very thick sheet of basaltic lava, which nearly filled up the lake-basin. The thickness of the flow considerably exceeds 100 feet, and may be as great as 150 feet on the average. The lava-field is about three miles and one-fourth in length, and a mile in width, and half environs the base of the cinder-cone. The cone itself is nearly 600 feet high, and the diameter at the base is about 3,300 feet. It is perfect in form, with a crater in the summit which is not broken down on any side. It is built of scoria and lapilli, the outer layers of which are like coarse sand, giving a smoothness and finish to the surface of the cone which I have seldom seen equalled. Great quantities of fine lapilli and 'ashes' are spread out over the adjoining country to a distance of two miles, and over the lava-sheet itself, quite burying it in some places. The impression of recency is conveyed by every aspect of the cone, of the lava-flow, and of the country round about. The rains have not, as yet, produced even the first trace of a water-channel upon the wonderfully smooth surface of the cone; and the only vegetation which has taken root is a single bush of Ceanothus, near the summit. The lava-sheet is rough and jagged in the extreme, but shows, as yet, no trace of weathering. For a space of four to five hundred yards from the cone, the trees were all killed. Most of them have fallen, and their decayed trunks are still lying on the ground, showing the marks of fire. In thirty-five years (the period assigned by Trask) such decay would be natural. Trees of the same species, felled certainly since 1850, show elsewhere in the vicinity an equally advanced stage of decay.

Whether the date assigned by Trask be the true one or not, the real date cannot be materially older. That the eruption was not at the time a matter of common fame, is readily intelligible; for the settlement of the northern part of the state did not begin until a year or two afterwards, and it is not probable that any observers except Indians could have witnessed it. Harkness adds, I believe, that it was still hot and feebly 'smoking' in 1852. This may be quite true; for the lava-sheet is an exceptionally thick one, and may have preserved its heat for a long time. And it may also have been seen by many white men in that year; for one of the routes by which overland emigrants poured into the state was laid in that year along the very base of the cone, and is known to this day as the 'Emigrant trail.'

I am not aware of any volcanic eruption in the United States which is so recent as this one. Vague accounts have been given of eruptions in Oregon, Washington Territory, and southern California within the last twenty years; but they have not been authenticated or confirmed by subsequent observation of the localities. There are lava-flows and cones in Utah, Arizona, and New Mexico, and also in southern California, whose ages must lie within a very few hundred years, but not within the present century. Unless something of the kind more recent is found in some secluded spot hitherto unvisited by the geologist, I think we may safely regard the eruption at Feather Lake as the most recent of any in the country.

A word or two about the country in which this volcano is situated. It is a volcanic region of great extent, covering probably twelve thousand square miles; and Lassen's Peak is its culminating point, and nearly its geographic centre. It is thickly studded with great volcanic piles, and buried thousands of feet deep in ancient lavas. Most of the eruptions are of great antiquity, and those which built the central pile of Lassen's itself are among the

oldest. Some of the volcanoes are younger, and a considerable number of smaller cones may have been built within a few thousands of years. C. E. DUTTON.

COMETS II AND III OF 1884.

IT is quite remarkable, that, of the five comets visible during the year 1884, four should have been periodic, and two of these of short period, and observed apparently for the first time at this return. By short period is generally understood a period of somewhere in the neighborhood of five years, of which we have well-known examples in the comets of Encke (3.3 years), Brorsen (5.5 years), Winnecke (5.7 years), Faye (7.4 years), etc., — twelve in all.

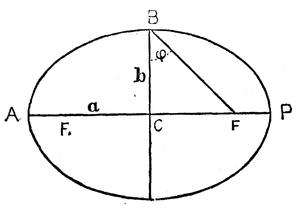


FIG. 1.

The new comets referred to are comets II and III of 1884, — the first discovered by E. E. Barnard of Nashville, Tenn.; and the second, by Max Wolf, a student at Heidelberg. Neither of these comets has been a conspicuous object, — not even visible to the naked eye, I believe, — but they are fair representatives of the class known as 'telescopic' comets.

As I have intimated, the orbit of comet 1884 II (Barnard), is elliptical with a period of about five and a half years. Making allowance for necessary uncertainty, the elements show a certain resemblance to those of DeVico's 'lost comet,' 1844 I, which, though certainly elliptical, has not been seen since, if we except a single rather doubtful observation made at Paris in 1855. The period agrees very well with that determined for DeVico's comet by Brünnow (5.469 years); but Berberich has pointed out that their identity cannot be assumed, for the time elapsed since 1884, forty years, does not correspond to any whole number of revolutions. He notes, also, that the physical appearance would seem to be against this identity; DeVico's comet, in a similar position with respect to the earth, having been visible to the naked eye. Leverrier thought it very probable that this comet of DeVico's was identical with one observed in 1678 by La Hire; and Laugier and Mauvais concluded that it was identical with the comets 1585, 1766 II, and 1819 III or IV.

Below are the elements of the two comets, brought together for comparison. DeVico's comet was computed by Brünnow; Barnard's, by Frisby.

Comet 1884 II (Barnard).

$$
\begin{array}{ll}
\mathrm{T} & = 1884,\ \text{Aug. } 16.2895,\ \text{Greenwich M. T.} \\
\pi & = 306^\circ\, 10'\, 9''.4 \\
\Omega & = 5^\circ\, 23'\, 51''.2 \\
\omega & = 300^\circ\, 46'\, 18''.2 \\
i & = 5^\circ\, 24'\, 48''.7
\end{array}
\left.\vphantom{\begin{array}{l}a\\a\\a\\a\end{array}}\right\}\ \text{Mean equinox, 1884.0.}
$$

$$
\begin{array}{ll}
\phi & = 34^\circ\, 51'\, 49''.3 \\
\log a & = 0.474164. \\
\mu & = 689''.858. \\
\text{Period} & = 1878.65\ \text{days.}
\end{array}
$$

Comet 1844 I (DeVico).

$$
\begin{array}{ll}
\mathrm{T} & = 1844,\ \text{Sept. } 2.511238,\ \text{Berlin M. T.} \\
\pi & = 342^\circ\, 30'\, 49''.6 \\
\Omega & = 63^\circ\, 49'\, 0''.1 \\
i & = 2^\circ\, 54'\, 50''.3
\end{array}
\left.\vphantom{\begin{array}{l}a\\a\\a\end{array}}\right\}\ \text{Mean equinox, 1844, Sept. 0.}
$$

$$
\begin{array}{ll}
\phi & = 38^\circ\, 8'\, 42''.0 \\
\log q & = 0.0742308. \\
\mu & = 649''.1503. \\
\text{Period} & = 1996.46\ \text{days.}
\end{array}
$$

Motion direct.

Let me try to show how these elements represent the orbit of a comet, and to give an idea of the shape of this orbit, and its position in space with respect to the sun and earth. By far the most satisfactory way of doing this would be to construct from the elements a cardboard model, which I think can be done with little difficulty from the following directions.

We know, that, in obedience to the law of gravitation, comets must move about the sun in some form of conic section, — the ellipse, parabola, or hyperbola. As a matter of fact, for the majority of comets, the orbit is given as a parabola; a few are known to be elliptic; but it cannot be said with certainty that any are hyperbolic.[1]

We are first to fix the shape and dimensions of the curve, and then its situation with reference to the plane of the ecliptic, in which the earth moves.

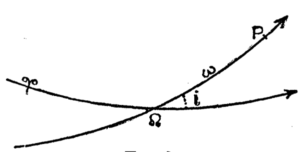


FIG. 2.

Suppose, for a moment, that the orbit is an ellipse, the sun being at one focus (F, fig.1). Two of the 'elements' determine the form of the ellipse: —

1. The semi-major axis CP, which is denoted by the letter a.

2. The eccentricity e, the ratio of the distance from the centre to the focus, to the semi-major axis; that is,

$$e = \frac{CF}{CP}.$$

[1] Newcomb's 'Popular astronomy.'

For the ellipse the eccentricity is always greater than 0, and less than 1; and, the nearer it is to 1, the more elongated is the ellipse.

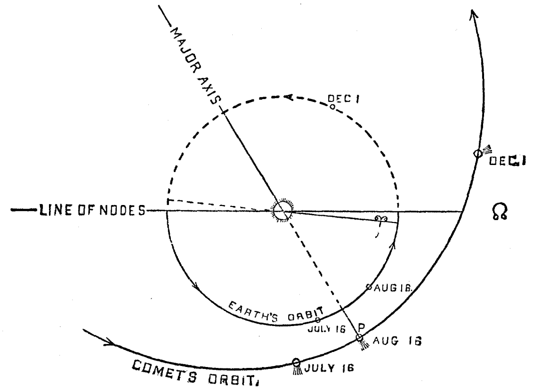


FIG. 3.—ORBIT OF BARNARD'S COMET.

Instead of e, the 'eccentric angle' ϕ, or *CBF* in the figure, is sometimes given; but from it we can obtain e by means of the relation

$$e = \sin\phi.$$

I might say that the linear distances a and e are usually expressed as decimal parts of the earth's mean distance from the sun. If $a =$ 2.98 (as in the case of Barnard's comet), it means that the mean distance of the comet, or the semi-major axis of the orbit, is 2.98 times that of the earth, or about two hundred and seventy-six million miles. So, generally, measurements expressed in this way are reduced to miles by multiplying by ninety-two and a half million.

Having settled the shape of the orbit, we must determine its position in space. For this purpose three more elements are required:—

3. The longitude of the ascending node, the angular distance from the first point of Aries (♈, fig. 2) to the point in which the comet pierces the plane of the ecliptic in passing from the southern to the northern side. It is usually denoted by the symbol ☊. The opposite or descending node is denoted by the symbol ☋.

4. The inclination, i, of the plane of the comet's orbit to that of the ecliptic.

5. The longitude of perihelion, π, which in fig. 2 is the arc ♈☊ + ☊P, or

$$\pi = \Omega + \omega.$$

6. Finally, we must state where the comet is in its orbit at some specified time. For comets we generally give the date of perihelion passage, T.

To these six elements there might be added the mean daily motion, μ, expressed in seconds of arc; and the period of revolution, sometimes called U, in days or years.

With the semi-axes a and b given (b is obtained from a and ϕ by means of the formula, $b = a \cos\phi$), the curve is constructed to any scale we please. I have found it convenient to use a scale of two inches. The earth's orbit is then represented with sufficient

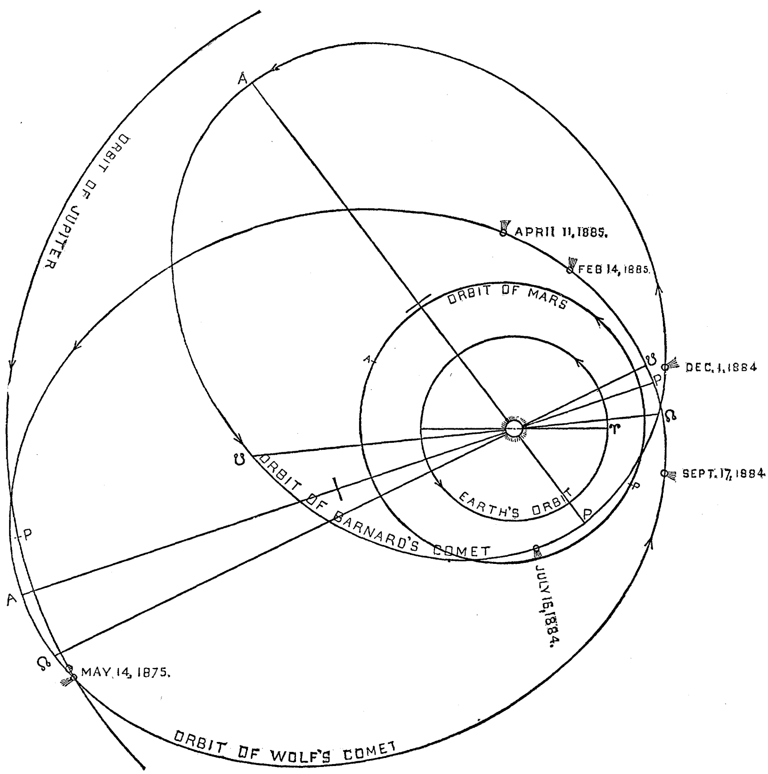


FIG. 4.—ORBITS OF COMETS 1884 II AND III.

accuracy by a circle with a radius of two inches; and on the circumference we mark the vernal equinox (♈, fig. 3), — a zero point from which longitudes are to be measured. We count in the direction opposite to the hands of a watch, which is also the direction in which the earth moves. We mark also the 'line of nodes' (fig. 3), — the line in which the two planes intersect, making the angle ☊ with the line of the equinoxes.

is 'retrograde,' they will be moving in opposite quadrants. The centre of our circle, and the focus of our ellipse, are, of course, made to coincide.

For a parabolic orbit, the construction of a model is not materially altered, though there is this important difference between a parabola and an ellipse. The parabola is an 'open' curve, and, the farther we recede from the sun at the focus, the farther apart do the branches become; and consequently a comet moving in such an orbit, will, if undisturbed, 'double' the sun, and then go off forever on its journey through space.

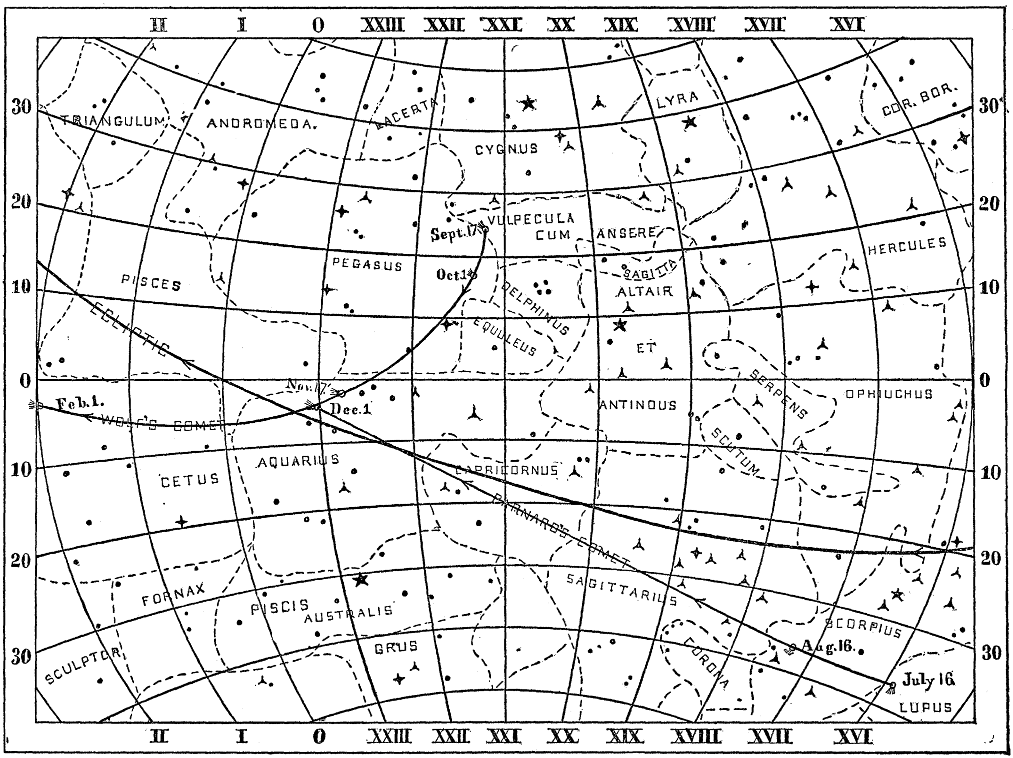


Fig. 5. — Apparent paths of comets 1884 II and III.

The next thing we want to know is how the major axis of the comet's orbit is pointing. This is determined by supposing that P and ☊ (fig. 2) at first coincide, and then that P is moved till $P☊ = \omega$ (in fig. 3 this angle is 300° 46′, so that the acute angle ☊⊙P is 59° 14′). The planes are inclined at the angle i (not shown in fig. 3, but given in fig. 2); and it only remains to fasten the two pieces of cardboard in this position, cutting a slit in either one, so that they will fit together. If the comet's motion is 'direct,' the comet and earth will be moving in the same quadrant, as they move away from the node. If its motion

For the parabola, the elements are given in a little different form. The eccentricity is equal to 1. The major axis stretches out to infinity, and we give in its place the perihelion distance q, and the distance from the focus to the vertex of the curve PF (fig. 1). But five elements are then necessary to represent the parabola.

Collecting these symbols for reference, they are as follows: —

T = time of perihelion passage.
π = longitude of perihelion.
$\omega = \pi - \Omega$.
Ω = longitude of the ascending node.
i = inclination of orbit.
e = eccentricity = $\sin \phi$.
ϕ = eccentric angle.
a = semi-major axis, or mean distance.
q = perihelion distance.
μ = mean daily motion.
U = period of revolution.

The equinox to which the elements are referred is given, since the vernal equinox is continually shifting on account of the slow motion of precession.

With what has gone before, I think that very little need be said in explanation of fig. 3, which is drawn from a model made as I have just described. The true form of a portion of the comet's orbit is given, and upon it is projected the earth's orbit, which, with such a small value of i, appears here again as a circle. The positions of the earth and comet are given for several dates.

Fig. 4 shows the entire orbit of Barnard's comet (as well as that of Wolf's comet, presently to be mentioned), the earth's orbit, that of Mars, and a small portion of the orbit of Jupiter. These orbits are all represented in one plane, and on so small a scale the inclinations are not great enough to cause any appreciable distortion. For the comets, the lines of nodes and the major axes are drawn in. Perihelion in all of the orbits is marked *P;* aphelion, *A*.

Fig. 5 is a map of a portion of the heavens showing the apparent path of the comet among the stars during the period of its visibility. It was in the constellation Lupus when first seen, and moved towards the north and east, through the constellations Scorpius, Sagittarius, Capricornus, and Aquarius. The place of the comet is given here, also, for July 16, the date of discovery; Aug. 16, perihelion passage; and Dec. 1, the limit of visibility.

COMET 1884 III (WOLF). — Wolf's comet, an insignificant object physically, is moving in an orbit of unusual interest. Its period is about six and three-fourths years. The entire orbit is shown in fig. 4, where two of the most interesting peculiarities are brought out, — a near approach to Jupiter in longitude 209°, May, 1875 (about eight million miles); and a near approach, at the descending node of the comet, to the orbit of Mars. From both of these planets the comet is evidently liable to considerable perturbation, and its past and future history become matters of some uncertainty.

Our chart shows a large part of the comet's apparent path in the heavens during its visibility. WILLIAM C. WINLOCK.

GEOGRAPHICAL NOTES.

THE roll of geographical journals is increased by one. The Florentine section of the Italian African society has been authorized by the central council and treasurer to issue a bulletin, the first two fasciculi of which appeared recently. It is intended to be partly eclectic, presenting geographical and especially African news to its readers, and partly the official record of the proceedings of the section. The present number contains an address by Professor Licata on the *rôle* of Italy in the Red Sea, an article by A. Mori on Massowah, and other matters of the same sort; bibliography, including a notice of a number of papers on the zoölogy of Africa, which have appeared from time to time in the annals of the civic museum of natural history in Genoa; African notes; the proceedings of the society; and the annual address of Vice-president Stefanelli on the operations of the section for 1884. The new journal is free to members, or may be subscribed for at the secretary's office, Via San Gallo No. 33, Florence, at the rate of five lire per annum.

Dr. Sériziat has been for two years engaged in collecting Lepidoptera at Collo, in the more wooded district of Algeria, reaching some thirty-five hundred feet above the sea. He has obtained about a hundred and eighty-four species in all, — about as many as are ascribed to the whole of Algeria in the most recent catalogue. There are about fifty-two diurnal species, — just half as many as are found at Basle in Switzerland. The cause of this deficiency is stated to be the small number of succulent plants suitable for the food of larvae, and the incredible multitude of insectivorous birds. It would be a source of gratification if Collo would lend to America her surplus of the latter in place of our own ineccfiient wild birds; and our climate would, perhaps, be quite well suited to the Algerian birds, at least in certain regions.

On the occasion of the presentation to the Russian representative, of the gold Vega medal recently awarded by the geographical society of Stockholm to Prjevalski, Mr. Elfwing, the American consul, made an address on behalf of the society, which was much appreciated, and which has been reproduced in the 'Revue géographique' of Renaud. Mr. de Berends made a suitable response on behalf of the absent explorer. This is the third award of the medal, the previous recipients being Baron Nordenskiöld and Capt. Palander.

The death of Madam Carlo-Serena, author of geographical articles on the Caucasus, is announced as having occurred in 1884 at an obscure village — Oedips — in Greece, on the borders of the Aegean. She was chiefly noted for her passion for mountain travel, and the courage and energy with which she

bore the concomitant privations and physical exertion it required.

The first general assembly for 1885, of the Geographical society of Paris, took place on the 24th of April. The president, Mr. de Lesseps, gave a brief address, in which he touched upon the much greater sensitiveness to occurrences in little-known lands, which the extension of telegraphs and means of transportation has brought about among the more civilized nations; and the growing importance, from all points of view, of geographical instruction in schools, universities, and even in the reading-matter furnished the general public by the daily and periodical press.

Dr. Ballay, in an address on the new possessions of France in Africa, sums up by saying, that while the Ogowé can never be rendered navigable, it can at least be made useful for *bateaux*. Its basin is naturally fertile, and rich in resources. On the other hand, the country extending from this basin to the Kongo is generally sterile. Ivory is about the only product. There is little to hope for from this region; but it is the beginning of the practicable route for reaching the trade of the upper river, which has inhabitants of intelligence and thrift. The natural products of all this region, such as rubber, ivory, etc., may be expected to become rapidly exhausted. It should therefore be provided that artificial cultivation, new industries and crops, should be introduced and directed by the whites. In this way a permanent trade will arise, and commerce be permanently benefited.

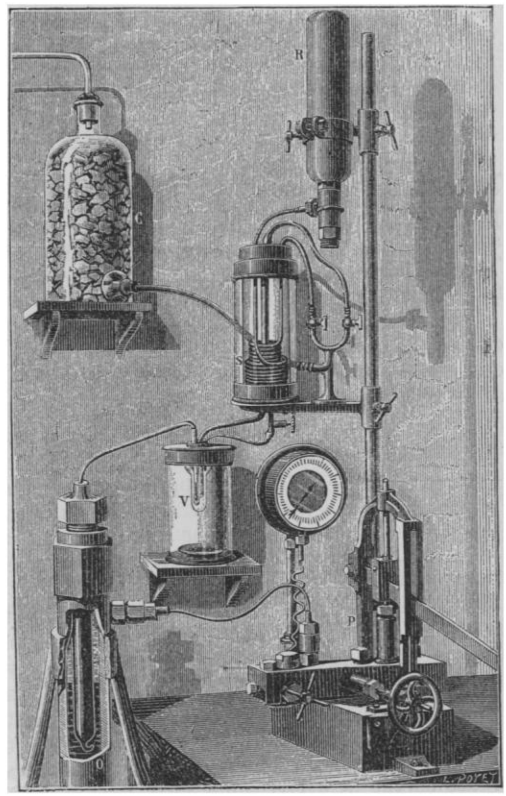
From Iceland, under date of March 21, we learn that the shocks of earthquake which had devastated the vicinity of Husavik, North province, began Nov. 2, 1884, and continued at short intervals, but less energetically, until the 25th of last January. On this day stables were thrown down, springs burst from the ground in new places, and small elevations were visible in a formerly level sandy plain. It is singular that on every historical occasion when earthquakes have been felt in Spain, Iceland has simultaneously suffered: this may be due, however, to the prevalence of earthquakes in Iceland at all times.

The Corwin has returned from Bering Sea to San Francisco for some repairs. She reports the sea ice unusually far south in April and May in that sea. No whales had yet been taken.

THE LIQUEFACTION OF OXYGEN.[1]

LIQUID ethylene, the use of which I have already explained to the Académie des sciences, furnishes, when boiled in the open air, a cold sufficient to cause oxygen, if compressed and reduced to this temperature, to present, when the pressure is diminished, a hard boiling appearance, which continues for an appreciable time. By evaporating the ethylene by the air-pump, the temperature is sufficiently lowered to reduce the oxygen to a liquid state. I have endeavored to avoid the inconvenience and complication which result from working in a vacuum, and to this end have already suggested the use of liquid methane, by means of which the liquefaction of oxygen and nitrogen may be easily brought about.

I thought, however, that, notwithstanding these advantages, ethylene, which is so easily prepared and handled, ought to be preferred to methane; and, by means of ethylene boiled in open jars, I have succeeded



CAILLETET'S APPARATUS FOR THE LIQUEFACTION OF OXYGEN.

in reducing the temperature sufficiently to cause the complete liquefaction of oxygen. The process I use is very simple, and consists in evaporating the ethylene by forcing into it a current of air or of hydrogen at a very low temperature. In my apparatus, the steel receiver *R*, which contains the liquid ethylene, is attached to a copper worm three or four millimetres in diameter, closed by a screw-tap arranged in a glass jar, *S*. On turning into this jar some chloride of methyl, the temperature falls to $-25°$; but if we blow into this air which we have dried by passing it through a flask, *C*, containing chloride of calcium, we soon have a cold of $-70°$. The ethylene thus cooled condenses, and fills the worm. When the tap is opened at the base of the jar *S*, the ethylene flows

[1] Condensed from *La Nature*, May 16.

under a slight pressure, and without apparent loss, into the glass gauge V, set, as shown in the figure, in a jar containing pumice-stone saturated with sulphuric acid, to absorb the water-vapor. It is indispensable to work in absolutely dry air; for otherwise the moisture of the air will condense in the form of an icy film on the walls of the gauge, which will become perfectly opaque.

It is then only necessary to evaporate the ethylene by means of a rapid current of air or of hydrogen cooled in a second worm, placed in the jar of chloride of methyl, S, to cause the oxygen compressed in the glass tube attached to the upper part of the reservoir O to be resolved into a colorless, transparent liquid separated from the gas above it by a perfectly clear meniscus. By working the pump P, the water acts on the mercury in the receiver O, and forces it into the gauge which contains the oxygen. The gas thus compressed liquefies in the branch of the tube in the gauge V. This tube dips into the ethylene at a temperature of $-125°$. The mass of liquefied oxygen, which is as limpid as ether, is figured in black in the figure in order that it may be visible. By means of a hydrogen thermometer, I have measured the temperature of the ethylene, which in one of my experiments I found to be $-123°$. I am in hope, that, by cooling the current of hydrogen more carefully, the temperature may be still further reduced. The copper worms in which the air and ethylene circulate are dipped into the chloride of methyl, which is rapidly evaporated by a current of air previously cooled. In conclusion, by evaporating liquid ethyl by a current of air or hydrogen much reduced in temperature, its temperature may be reduced below the critical point of oxygen, which in this way liquefies in the clearest form. This experiment is so simple and easy to perform, that it may enter into the regular course in a laboratory. L. CAILLETET.

THE FORM OF SHIPS.[1]

IN the course of his address, the lecturer briefly explained the great development which the science of fluid resistance had undergone of late years, largely owing to the labors of Stokes, Rankine, and others, but more largely still to those admirable investigations which had been carried out, under the patronage of the admiralty, by the late Dr. William Froude, and subsequently by his son, Mr. R. E. Froude. He likewise explained the very great effect which those investigations had produced in the royal navy, owing to the judicious and prompt adoption of Froude's results by the admiralty constructors. Stress was laid, throughout the lecture, upon the importance of adjusting the form and proportions of ships, not only to the loads which they have to carry, but likewise to the weight of the materials entering into their structure. It was a common error to judge of the merits of steamships by the relations which exist between their displacement, steam-power, and speed, as expressed by formulae of various kinds. Approximations to the theoretical form of least resistance were sought by some naval designers, and all considerable departures from that form were regarded as objectionable. The lecturer, on the contrary, pointed out that no such theoretical form was any true or proper guide for a naval designer, since every change in the average weight of the hull necessitated a corresponding change in the form and proportions of the ship; and the great merit of a designer often was, that he adopted forms differing widely from the abstract forms of the schools, and presenting a very inferior appearance when put into what are known as 'constants of performance.' This was illustrated by examples derived partly from actual ships, and partly from calculations made for the purpose. Two actual war-ships were compared, one attaining the high figure of 213 marks when examined by the received formulae, and the other gaining but 172 marks ; yet, in the lecturer's view, the latter was far the better ship, because she performed precisely the same service as the other, being inferior in no respect, and yet had cost less than the other by £114,000, and expended no more steam-power in attaining an equal speed. The lecturer remarked, that he should probably have regarded the abstract 'form of least resistance' with more respect but for the circumstance that the designing of armored vessels, in which he was much engaged, was "a branch of naval construction of much too concrete and ponderous a character to admit of any dalliance with abstract or fancy forms." He went on to express his regret, that owing largely to the restrictions which granite docks imposed upon naval constructors, and to the absence of iron floating docks capable of receiving ships of any form, and owing to other causes likewise, the construction of armored ships — by which he meant ships which had a sufficient volume protected above the water to keep them afloat and upright while the armor remained intact — had been abandoned, and the first place upon the sea had been offered to any nation which had the courage and the will to assume it. In his opinion, this was a purely voluntary abandonment, and was not the result of any scientific or economic necessity. He admitted that great changes in forms and proportions were very desirable in our great line of battle-ships : for example, a great increase of breadth was necessary in order to economize the side-armor, and to keep the ram and torpedo at ample distance from the boilers and magazines, which should be protected by an inner citadel, so to speak, well removed from the outer one. But, so far was true science from presenting obstacles to these and other important changes, it actually invited these very changes; and increase of beam in particular had been shown by Froude to facilitate the attainment of practical invulnerability combined with very high speed. Size and cost were among the bugbears of our naval administration: by the true engineer they were always regarded as secondary to great and noble objects, among which objects he included the naval pre-eminence of England. At any rate, there was no engineering

[1] From a lecture before the Institution of civil engineers by Sir EDWARD REED.

obstacle whatever to England constructing and sending to sea, not merely those great and swift, but delicate and fragile, Atlantic hotels in which the British navy was to embark and fight, for the want of something better, but also war-ships, — real war-ships, capable of bearing the once proud flag of England boldly into the waters of any enemy whatever.

BONE-CAVES IN WALES.

FROM a careful study of the bone-caves in Wales, Dr. Henry Hicks (*Proc. geologists' association*, vol. ix. No. 1) makes some very important conclusions in regard to the contents of the caverns. The evidence shows that the area of North Wales was subjected to very great physical changes during pleistocene times. In the earliest part of the period it was raised to a considerably greater elevation than it is at present, and depressed afterwards in interglacial times to a depth of at least two thousand feet, so that it became a mere cluster of islands. After that, the area gradually rose again, with slight oscillations of level, until it attained its present configuration. Deposits relating to all these changes are to be found either on the Welsh hills or in the valleys, especially in those surrounding the Vale of Clwyd. If an attempt is made to correlate the deposits in the caverns with the glacial drifts of the neighborhood, — the results of the changes referred to, — one would be inclined to look upon the lowest drift in the caverns, that consisting mainly of local materials, as belonging to an early part of the glacial period, i.e., before the great submergence. Possibly this material was introduced into the cavern when the river flowed in the valley at a much higher level than at present, as it has much the appearance of that usually brought down by river-action. As time went on, and the valley became deepened, so that the caverns were above the reach of the floods, they probably became the abodes of hyenas and other beasts of prey, or places where animals retired to die. During the epoch of great submergence, as soon as the caverns were on a level with the sea, they were probably filled with sand, and the animal remains became entombed in them. This sand is now found in the cavities of the bones, and occasionally cemented to them. In the period of upheaval which followed, as soon as the water was again on a level with the caverns, it washed out most of the sand, and carried in with it, instead, the muddy and other materials which had been deposited in the neighborhood by floating ice. By this means there was produced a general re-arrangement of the contents of the caverns. It was as the waters receded that the upper bowlder-clays were deposited both in the valleys and caverns. The abundance of bones in the caverns, and their very rare occurrence in the bowlder-clays of the valleys, prove almost conclusively that they must have been accumulated in the caves, and not washed in from the bowlder deposits near by. The proof furnished that the bones must have been buried in a marine sand before they were enclosed in the present cave-earth, is strong evidence that the animals occupied the cavern in very early glacial times. Whether man also lived in the area at so early a period, cannot at present be decided by any evidence, as the flint implement found with the bones in Cae Gwyn Cave might have been introduced at a later period. It is, however, interesting to know that it appeared to be associated with the reindeer remains, and that the type is supposed to characterize what is called in France the 'reindeer period.'

AN EDIBLE CLAM INTRODUCED ON THE ATLANTIC COAST.

AN interesting shipment of shell-fish has just been received at the Wood's Holl (Mass.) station of the U. S. fish-commission. It consists of nearly eight hundred living specimens of Tapes staminea from the shores of Puget Sound, in Washington Territory, where it is known as the 'little round clam.' It is not unlike the quahaug (Venus mercenaria) in general appearance, though differently ornamented, and not growing so large, and, as in the latter species, the valves fit closely together all around when the shell is closed. This clam is one of the most highly prized of the west-coast species, of which there are several used as food. It is marketed in large quantities in all of the principal towns, and would form a valuable addition to the food-products of the Atlantic coast, if it could be made to thrive here.

The shipment was made in one of the fish-commission cars, in charge of Mr. George H. H. Moore, and was obtained at Henderson's Bay, near Tacoma, Washington Territory, where the clams live on sandy and gravelly bottoms about the level of low tide. Between four thousand and five thousand specimens were secured, and first packed in wet sand, in the large stationary tanks on both sides of the car, filling a space about twenty-four feet long by two feet wide. The sand was moistened twice a day with sea-water at a temperature of about 56° F. During the first four days not over fifty of the clams died; but at the end of that time, as they were evidently not doing well, they were taken from the sand, and kept for a few hours in pure sea-water.

Then they were transferred to a bed of sand in which the shells were laid with the ventral margin uppermost, and covered with rock-weed which was kept constantly wet. During the next two days the mortality was very great, and it was thought best to try the salt water again. They were accordingly placed in tin cans of sea-water, in which they completed the rest of the journey, arriving at Wood's Holl, Friday, June 26, about seven days from the time of leaving Tacoma, where, however, they had been kept in the tanks two or three days before starting. On the last day of the trip, over seven hundred were lost, and the exact number received at Wood's Holl was seven hundred and sixty-eight. These were transferred to a suitable sandy beach, into which many began to burrow at once. It is impossible to predict how many of those brought over will recover

from the shock of the long journey, but a number appear to be active in their new home.

In this connection it may be interesting to note that the common east-coast soft clam, Mya arenaria, which was introduced on the Pacific coast several years ago, has become thoroughly acclimated there, and is now very abundant.

WORK OF THE CHALLENGER EXPEDITION. — II. FROM A ZOÖLOGICAL STAND-POINT.

After the investigation of the physical features of the world of the sea, it was expected and has proved that the greatest additions to our knowledge would be made by the expedition in the direction of biology. From the summaries furnished by the specialists engaged on the various monographs, and printed at intervals in the text of these volumes, a few facts may be cited in the endeavor to give an approximate idea of the scope and character of the results.

The main purpose of the expedition, on the biological side, was to investigate the marine life of the sea, and incidentally to examine the life of certain isolated oceanic islands, — faunae pregnant with meaning for the naturalist, though scanty in species or individuals. Both objects were carried out in a manner satisfactory to naturalists, and creditable to the officers of the expedition. The air-breathing vertebrates, of course, were little sought after, but interesting observations are recorded on the sea-elephant and fur-seal; and the bones of cetacea dredged from the sea-bottom were sufficiently numerous and interesting to justify a special report on them by Professor Turner. The expedition seems to have needed a live harpooner, for it got no porpoises during the whole voyage, though many played about the ship. The birds collected, though not extremely numerous, were of great interest, and have been reported on by Dr. Sclater, the Marquis of Tweeddale, Dr. Finsch, Count Salvadori, Messrs. Saunders, Salvin, and Garrod. The death of the latter prevented the completion of his work on the anatomy of the petrels, which was taken up by the late W. A. Forbes, who made an exhaustive report on the subject, showing that the order of Tubinares must be divided, as proposed by Garrod, into two very distinct families characterized by numerous and important differences, — which indicate not only a great antiquity for the whole group, but a great amount of extinction among its past members, in the process of which nearly all the intermediate or less specialized forms are believed to have disappeared. Professor Cunningham has reported on the marsupial mammals; Professor Parker, on the development of the green turtle; and Professor Turner, on the human crania collected during the voyage. The report on the deep-sea fishes, by Dr. Günther, is still a desideratum, but will unquestionably be of great interest. Some preliminary notes appear in this volume. A great similarity between the fish fauna of the Japan seas, the West Indies and adjacent Atlantic Ocean, and the Mediterranean, is clearly shown. At St. Paul's Rocks a new species of Holocentrum was found, but the fish fauna had a generally Antillean character. A remarkable fish, Bathypterois, was found on the coast of Brazil, with rudimentary eyes, and part of the pectoral fins modified to form extremely long tactile filaments. Another, Ipnops, dredged in the ocean at a depth of 1,900 fathoms, had the eyes modified to such an extent as to resemble two scale-like plates on the top of the much-flattened muzzle. No image can be formed in them, but they may serve for detecting minute quantities of light. Still another, Echiostoma, has eyes and formidable teeth, with long filaments extending from the chin and pectorals. A series of luminous globular bodies extends along the lower part of the body, and others of larger size are found on the head. The bones and ligaments of the deep-sea fishes are very soft, and the muscles loosely connected with each other. This is partly due to the expansion which they undergo in being raised quickly from regions where the water permeating all their bodies is under immense pressure; but the tissues must be loose to admit of such permeation, or they would be crushed and ruined under a weight which shivers solid glass to powder. Many of them are blind; many of them have phosphorescent organs, or secrete a phosphorescent slime; others have distensible stomachs and wide mouths, which ingulf fishes much larger than themselves.

Turning to the division of invertebrata, we find ourselves more than embarrassed with riches. The mollusks being in the hands of Rev. Boog-Watson and Mr. E. A. Smith of the British museum, who have so far submitted only preliminary notices, we learn chiefly of some special rarities, such as the paper-thin volute, Guivillea, from the depths of the Southern Ocean, or the beautiful Pecten Watsoni, of the section Amussium. Mr. Smith reports, in harmony with the results of the Blake expedition, that among the bivalves dredged from a depth of over 2,000 fathoms

he does not find one which might not have been expected at 100 fathoms or less. The deepest haul producing any bivalve was 2,900 fathoms, where Callocardia was found in the Pacific, and an almost exactly similar species was obtained at 1,000 fathoms off the Azores, in the same latitude of the Atlantic. On the whole, lamellibranchs were scarce: but this may have been owing to the use of the trawl instead of the dredge. The greatest depth at which any gastropod was found was 2,650 fathoms, in the South Atlantic; and this was a little Stylifer parasitic on an echinoid. The fossil genus Actaeonina was a find worth having; and many, like Gaza and other trochids, were of great beauty. A number of arctic species were found at home in the antarctic sea; and several others seem to wander over most of the world. Professor Haddon reports a chiton (C. [Leptochiton] alveolus Sars) from 2,300 fathoms, which was the only really deep-sea species found of this ancient group, though several others of the same genus range over 300 fathoms. Among the nudibranchs, an immense creature, Bathydoris abyssorum of Dr. Bergh, as big as a cocoanut (twelve centimetres long), forms a remarkable transition between Tritoniidae and Dorididae, and was obtained at 2,425 fathoms. It is the largest nudibranch known, and was purple, brown, and orange colored when alive. Among treasures from shallower water were a living Nautilus pompilius and a partly decorticated Spirula.

It is impossible to give an account of the varied, beautiful, aberrant, or exquisite forms of the crustacea, star-fish, echinoids, and brittle-stars which were brought up from the deep sea. Their attractions for the eye of the aesthete as well as of the naturalist are obvious to any one who may examine the charming woodcuts which illustrate their form and structure. The sea-lilies are among the most attractive; and yet it is hard to choose from among so many any special group as, on the whole, the most beautiful.

Among the worms, decidedly the most extraordinary is Syllis ramosa, — a creature living in sponges, not satisfied with shaking off its progeny by dropping sections from its tail, but which actually branches in all directions laterally, and shares with these collateral relations the ramifications of its stomach. In another form, Genetyllis, the head is composed of little more than two enormous eyes, with a large median nerve-mass with which the retina of each is continuous. Some worms have tubes five yards long: others ornament their dwellings with hyaline sponge spicules or spiny processes. They reach depths of 3,125 fathoms, and range to the surface, the Serpulae and Terebellae being the most noteworthy in this respect.

The consideration of the calcareous and horny sponges was undertaken by Dr. N. Poléjaeff of Odessa, who, after demolishing all previous attempts at their classification, aptly compares the systematist to a man wandering in the dark, — a condition in which the synopsis of his memoir certainly leaves its reader. The number of species was not large, and none of them came from great depths, though many were undescribed. The group of sponges to which the beautiful Venus's flower-basket, Euplectella, belongs, offers, as might be expected, many new and exquisite species, which are illustrated in a manner worthy of their attractions. Prof. F. E. Schulze reports that the Challenger collection has more than doubled the number of known species, which now amounts to more than one hundred. The tropical zone of the Pacific is the richest region, eighteen species having been obtained at one haul, in the vicinity of Papua; but the largest total number of species comes from the Southern Ocean. They are essentially abyssal animals. The richest additions to any single group of marine animals made by the expedition were to the Radiolaria. These rhizopods are now known to differ from the foraminifera and heliozoa chiefly by the separation of their unicellular body into an inner and an outer series of constituents. With few exceptions, they are remarkable for their skeletons, of the most varied and delicate form, and of siliceous or chitinous structure. They swim in numbers at the surface, or even at great depths; and the ooze at even the greatest known depths is often composed of astonishingly vast numbers of their delicate skeletons. From a few hundred known forms, the work of the Challenger has expanded the list to several thousands, among which Professor Haeckel has distinguished six hundred and thirty-four genera, included in twenty-four families and several orders. It must, however, be borne in mind that these systematic divisions are far from having the zoölogical value of divisions similarly styled in higher groups, though here perhaps necessary from the multitude of species. We have regretted the necessity, from considerations of space, for omitting references to the admirable and epoch-making work of Professor Moseley on the corals, confirming and extending the work of the elder Agassiz, or that on the foraminifera and diatoms, both of which exhibit forms of great beauty, which are excellently

figured. But nearly every page contains matter which would be of interest to readers of *Science*, and unfortunately we cannot yet print numbers in twelve hundred pages quarto. We are obliged to reserve our concluding paragraphs for the geological aspects of the voyage.

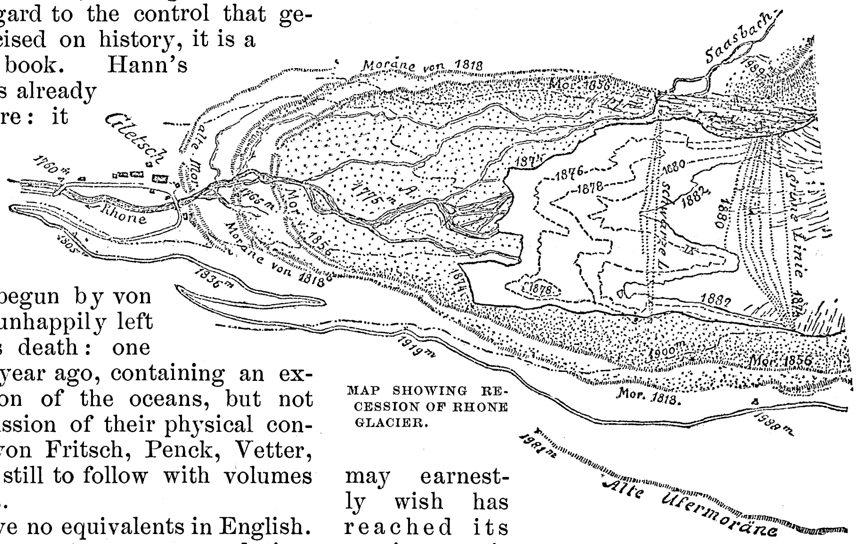
GLACIERS, AND THEIR RÔLE *IN NATURE.*

PROFESSOR RATZEL'S 'Bibliothek geographischer handbücher' reaches its fourth volume in Heim's comprehensive review of what may be called 'glaciology,' — a general discussion of glaciers, and the part they play on the earth's surface. It is fully up to the high standard attained by the earlier numbers of the series. Ratzel's 'Anthropogeographie' was the first issued; and, although somewhat venturesome in regard to the control that geography has exercised on history, it is a very suggestive book. Hann's 'Klimatologie' has already been reviewed here: it has everywhere received high praise, and at once takes its place as a standard work. The 'Ozeanographie,' begun by von Boguslawski, was unhappily left incomplete on his death: one part was issued a year ago, containing an exhaustive description of the oceans, but not reaching the discussion of their physical conditions. Drude, von Fritsch, Penck, Vetter, and Zöppritz are still to follow with volumes on special subjects.

These books have no equivalents in English. It is becoming very monotonous to record, time after time, that German writers are so far in advance of us; but the fact is very plain. If such works cannot be originated here, we wish that they might at least be translated and republished, so as to come within reach of our teachers and students.

Professor Heim has hitherto been known rather as a worker on mountain structure than on glaciers. His studies in the direction of the latter subject, so far as they are published, have been concerned chiefly with the share that ice has had in mountain sculpture; but the book now before us shows deliberate and careful work on all topics connected with glaciers of the present time. The reference made to their former extension is sufficient for a volume that professedly does not discuss that part of the question. As in the earlier numbers of the series, illustrations and references to authorities are practically wanting. An index is also absent in this volume; but its place partly taken by a well-arranged table of contents and page-headings. Our many students of the difficult problem of North-American glaciation will find much of value in the summaries of recent Swiss studies on the structure of glacial ice, of observations in Greenland on the motion of the great glaciers there, and of the many suggestions to account for glacial motion, as well as in the accounts of existing glaciers and their oscillations.

The remarkable recession of the Swiss glaciers during recent decades, which travellers



MAP SHOWING RECESSION OF RHONE GLACIER.

may earnestly wish has reached its maximum, is finely illustrated in the figure of the glacier of the Rhone, of which a part is copied here. The measurements carried on of late years, under the direction of the Swiss alpine club, give precise data on this matter, and, if continued long enough, will undoubtedly in the end lead to the discovery of the cause of glacial oscillations in the peculiarly dry or wet, warm or cold, weather of some antecedent series of years; the effect leisurely following the cause, as the excess or deficiency of upper snow supply arrives at the lower end of the ice-stream. A view of the Rhone glacier, as it was at its recent maximum extension about 1820, is given in de Charpentier's 'Essai sur les glaciers,' and offers a striking contrast

Handbuch der gletscherkunde. Von ALBERT HEIM. Stuttgart, *Engelhorn*, 1885. 16+560 p., map. 8°.

to the little remnant of ice at the foot of the steep slope, as seen by travellers of last summer.

The anatomy of the greatest glacial system of Switzerland, that which forms the Aletsch glacier, is excellently shown in a folded map. The scale is 1 : 50,000 ; contour lines are drawn in blue on the ice and snow every thirty metres ; the moraines are marked in detail ; and the peculiar zigzag bands in the ice, like the grain of wood, so conspicuous in the wonderful view from the Eggischhorn, are carefully represented. This map may therefore be ranked even above the interesting one of the 'Mer de glace' system (scale, 1 : 40,000) on Viollet-le-Duc's sheet of the 'Massif du Mont Blanc,' published about ten years ago.

The question of glacial erosion has always been fruitful of opposite views since it was first given importance by Ramsay ; and we have to regret that the summary of the matter presented by Heim does not go further in reconciling the apparently contradictory facts quoted by the advocates of the contrasted theories. Heim writes, 'Glaciation is a period of rest in valley-making.' Professor Newberry concludes[1] that a great glacial sheet, shod with stones and gravel, "would not only be capable of sweeping away any ordinary barriers that opposed its progress, but would grind down the underlying rock with a resistless and comparatively rapid action."

Neither of these authors gives sufficient indication of the more judicious middle ground taken by James Geikie and some others, to the effect that glacial action may be destructive in one district, and constructive in another ; that glaciers, like rivers, erode chiefly in their upper streams, and deposit the detritus quietly on the flood-plains and deltas of drift near their termination. The great amount of glacial drift undoubtedly affords the strongest argument that can be made in favor of the marked changes effected by glaciers, just as the vast volume of stratified fragmental rocks testifies to the successful persistence of water-action ; and for North America, at least, we cannot accept Heim's conclusion, that pre-glacial weathering afforded the chief part of the drift, while direct glacial erosion gave rise only to fine sand and mud. The occurrence of angular, unweathered, and unworn bowlders, and of drift rich in limestone, forbids such a conclusion, and has been successfully quoted against it. On the other hand, the evidence of the protective, or at least the very moderately destructive, action of the old glaciers near their termination, and the not excessive erosion in any part, is ably stated ; and, to our mind, this leads much nearer to the truth than does the path followed by those who see an argument for glacial erosion in nearly every lake of northern countries and every fiord of western coasts.

[1] School of mines quarterly, vi. 1885, 152.

HOUSEHOLD SANITATION.

IF the author succeeds in winning the audience she desires, she may justly claim pioneership in one direction of the higher education of women. The path indicated is not well beaten. Sanitary science is of late origin ; so late, indeed, that the men who formulated it are still young. Its proposition to prevent disease by removing the conditions that provoke disease, merits the popular approval, and legislation has been quick to help sanitarians put their science to the test. With plenty of money, and in fair localities, it is not difficult to satisfy all the demands of the sanitarians. It will, however, hardly be contended that the sanitarians have formulated insurance against the outbreak of the zymotic diseases for the ordinary householder in any locality where necessity has placed him. And yet this is the very problem which sanitary science is to solve. Much can be done in one home to make it healthful ; but the influences that affect one home are so intermixed with the influences that affect large areas, that state and national interference is demanded by sanitary science. The author has stated the sanitary conditions of healthful homes with accuracy, and with sufficient fulness to make these conditions readily comprehended. She appeals to the women of the land to familiarize themselves with the results of sanitary science, that they may be able to critically examine their own homes, and influence opinion, so that healthful conditions may be made compulsory under the law. This is good work, and the more of it the better. There is an immense chasm between crazy-quilts and sewer-pipes, sonatas and bad drainage ; but it can be bridged by informing the women, and teaching the girls. If rosy children and long-lived husbands are worth the while, this education in what constitutes a healthy home is worth a place in the school curriculum for girls.

Sanitary science is so new, that 'consulting sanitary engineers,' without warrant of author-

Women, plumbers, and doctors; or, Household sanitation. By H. M. PLUNKETT. New York, *Appleton*, 1885. 248 p., illustr. 8°.

ity, are plentiful, and 'sanitary plumbing' is the unvarying advertisement. Implicit faith in either class is ill advised. The skill of the one and the handicraft of the other may safely be questioned and criticised. The easy conscience of the contractor, no less than the ignorance of the owner, makes poor plumbing-work possible, for much of it is hidden from sight. Smoothly wiped joints, with brass and plated fixtures, do not always insure sound and honest workmanship. The complexity of this plumbing problem in the great cities, with their crowded populations, must be solved through the agency of general legislation, and the authority of inspection must be derived from stringent laws. The state boards of health were organized with this end in view, and their conclusions are influential with the law-making powers. Sanitary science includes so much, and affects all to the degree that *men* have no monopoly in its results. Mrs. Plunkett is right in contending that *women* should master these problems to aid in procuring compulsory legislation. Her little tilt at the doctors on the titlepage is very much softened in the final paragraphs of her book. The millennium is not quite at hand; and as the doctors discovered the causes that brought sanitary science into existence, and have done all that has been done thus far in formulating it, and as they must be the final court of appeal in all questions that arise before sanitary science is rounded out and complete, the medical profession will probably see several generations before its 'occupation's gone.'

NOTES AND NEWS.

THE following short account of a tornado at Aden, reported by Commander Merrill Miller, U.S.N., commanding the U. S. steamship Marion, is interesting from the fact that it is the first violent storm that has visited Aden since the English occupation. On June 1 and 2 the weather at Aden was sultry and threatening, with moderate easterly breeze and sea. The sailing-directions give no accounts of storms in this locality. On the morning of June 3 the wind was moderate from north-west, with heavy and increasing swell from south-east. The sky was dark and threatening. At ten A.M., June 3, the wind increased to a gale, with squalls of hurricane force from the northward, and rain in torrents, and very heavy seas from southward and eastward. The sea broke over the rail of the English flagship, which was battened down. The barometer fell to 29.60. At three P.M. the barometer began to rise, when the wind shifted to the southward and eastward, and the gale moderated. Heavy rain-squalls continued at intervals all night. The gale was of the nature of a tornado, and apparently passed up the Gulf of Aden in a westerly direction. Vessels arriving from the Indian Ocean and the Red Sea report having encountered heavy weather.

— Mr. I. C. Russell's reconnoissance in the northern part of the Great-Basin region, where it extends into southern Oregon (U. S. geol. surv., 4 ann. rep.), has furnished him with a quantity of interesting facts concerning this little-known part of the wide west. Its rocks are largely volcanic, spread out in great sheets of lavas that once formed a broad, smooth tableland; but in later times it has been broken by faults, so characteristic of the Great-Basin region, and thus divided into long, narrow blocks, stretching north and south, and tilted by very recent displacements, so as to expose fresh precipitous scarps that have not yet sensibly worn back from the fault-lines. In the Warner valley, for example, the orographic blocks of dark volcanic rock, miles in length, are literally tossed about like the cakes of ice in a crowded floe, their upturned edges forming bold palisades that render the region all but impassable. The faces of the numerous branching fault-cracks present naked precipices without system, that combine to make a region of the wildest and roughest description. The depressed areas were occupied, during quaternary time, by numerous lakes of considerable size. Some overflowed to rivers that reach the ocean, like the Klamath, that escapes westward through the Cascade Range; others contributed to the supply of the irregular basin of Lake Lahontan, farther south; and some had no overflow, their influx being counterbalanced by evaporation, thus indicating that the precipitation of the time was not excessive, and that their waters were saline. At present the waters have retreated from the terraces and benches that mark their former levels, and remain in greatly diminished volume. Some have altogether disappeared, or appear only in the wet season; others are relatively permanent sheets of very saline water, like Summer and Abert Lakes, which may possibly inherit part of their dissolved salts (soda and potash) directly from their larger ancestor; but the most numerous are those which are now essentially fresh, although occupying basins from which the quaternary lakes had no outlet (these are therefore not to be considered remnants left by the incomplete evaporation of the quaternary lakes whose basins they occupy, as in that case they should be densely saline). Their freshness is best explained by Gilbert's hypothesis that the quaternary lakes have been completely dried up, and their saline contents so well buried under playa-mud, that the waters subsequently accumulating in the basins did not take them into solution. Mr. Russell finds no evidence of either local or general glaciation in the region he examined, and thus differs in his conclusions from those reached by LeConte. The report is illustrated by several maps, showing fault-lines, quaternary and existing lakes, by numerous cuts illustrating the peculiar displacements so characteristic of the region, and by a sketch of Abert Lake, in which the tilted blocks that form its basin are shown. It is a valuable and most inter-

esting chapter to add to the physical geography of our country.

— The Portuguese explorer, Serpa Pinto, has found considerable coal-beds south of the Rovuma. The Rovuma flows into the Indian Ocean, south of the German possessions on the east coast of Africa, on the old caravan track from Cape Delgado to Lake Nyassa. These coal-beds were claimed by the sultan of Zanzibar; but, as they lie south of the Rovuma, the Portuguese have taken possession of them.

— Professor Forel of Morges continues his reports to the Swiss-Alpine club, on the periodic variations of the glaciers of the Alps, and in his fifth statement, for 1884, confirms the conclusion announced a year ago, that the decrease of thirty-four distinct glaciers has come to an end, and is now followed by a moderate advance. In the valley of Chamounix, the glacier of Argentière crept forward thirty-three feet last year: it had a maximum in 1819, and again in 1854, followed by a minimum in 1883. The Glacier des bois, at the foot of the Mer de glace, shows no change; but that of the Bossons is advancing rapidly, having extended its front about one hundred and fifty feet in the past year; and so with a number of others. Part of the Hôtel des Neuchâtelois, from which Agassiz made his early observations on the Unteraar glacier, has been found twenty-four hundred metres down stream from its position in 1842, giving an average annual velocity of fifty-five metres; but it is curious to note, that as its velocity from 1842 to 1846, when determined by Agassiz, was seventy-three metres a year, its recent velocity must have been about forty metres, to bring the forty years' average down so low as fifty-five. Another peculiar fact found by Forel is that the recent change from retreat to advance is much more common in the western than in the eastern Alps. The observations of the next few years promise to be of special interest in this connection.

— Capt. Downie of the British steamer St. Andrew's Bay, reports that on June 25, in mid-ocean, a meteor resembling a ball of fire two feet and a half in diameter descended from overhead a short distance from his vessel. This occurred about noon. The weather was misty and rainy, but there had been no lightning or thunder. The flash made by the passing meteor was so brilliant that it blinded those who witnessed it. The meteor exploded with a terrific report, resembling cannonading, followed by a noise like the rattle of musketry. Immediately after the passage of the meteor the weather cleared up. The vessel was loaded with iron ore, but there was no play of electricity upon any part of her.

— The third report of the Swiss seismological commission, by Forel, covers the years 1882 and 1883. It gives a list of the earthquakes observed during the two years in Switzerland, with the accessory shocks. The intensity of each earthquake is marked according to the Rossi-Forel scale, and its 'value' computed by the formula adopted by Forel in previous reports, which takes into account the intensity number, the extent of the seismic area, and the number of accessory shocks. These numbers are tabulated, and compared with the mean of the two years 1880 and 1881, and with the separate numbers for those years. The means deduced from the several tables are as follows: —

	1880.	1881.	Mean of 1880–81.	1882.	1883.
Number of earthquakes . . .	–	–	29.0	29.0	15.0
Number of shocks,	–	–	116.0	49.0	19.0
Mean intensity .	3.9	4.2	4.0	3.7	3.6
Mean 'value' . .	10.1	15.1	–	7.4	5.7
Annual sum of 'values' . . .	211.0	574.0	273.0 *	220.0	87.0

* Mean of the four years.

From these figures the author infers that there was a maximum of seismic activity in Switzerland in 1881, which a comparison of the *monthly* values shows to have been in November of that year; and that in 1882 and 1883 the activity was notably diminished, especially so in the latter year, in which only one earthquake (Jan. 8) exceeded a value of 10, and none exceeded 15. In the figures tabulated, no account was taken of twenty-one slight shocks, twelve in 1882, and nine in 1883, which were only reported by a single observer.

— Dr. M. E. Wadsworth has accepted a position as professor of mineralogy and geology at Colby university, Waterville, Me. We understand, that, as at Cambridge, he will continue to give instruction to advanced students in lithology; and there will thus be one more opportunity for those who intend pursuing this growing science to familiarize themselves with the latest methods of investigation.

— The Berlin congress, says the *Athenaeum*, appears to have stirred the Portuguese Commissâo de cartographia into activity. Among a batch of maps recently forwarded to us from Lisbon, we find a capital general map of the province of Angola, compiled by A. A. d'Oliveira, on a scale of 1:3,000,000, which distinguishes salubrious from insalubrious districts, and shows, among other novel features, the recent routes of Capello and Ivens to the east of Mossamedes; a map of the country between Loanda and Ambaca, on a scale of 1:400,000, based upon railway surveys made by Major A. S. de Souza Prado, Major Goyâo, and others, and of much original value; and, lastly, a map of the lower Kongo up to Noki, from recent surveys by L. de Moraes e Souza, C. de Magalhaes, and E. de Vasconcellos. These maps are reproduced from autographs, and their external aspect is consequently not very inviting; but they contain matter which the cartographer cannot afford to neglect. We are glad to hear that maps of the island of St. Thomas, of Angola (on a scale of 1:1,500,000), and of Mozambique, are preparing by the Commissâo de cartographia, under the direction of Senhor Leite.

— A remarkable instance of the tenacity of old beliefs among an ignorant class lately occurred not

very far from Calcutta. The idea that government always inaugurated every good work with human sacrifice was long current among the lower orders of the Indian people; but it might be supposed that it had died out long ago. It appears, however, to be as strong as ever. The boatmen on the Ganges near Rajmehal somehow came to believe that the government required a hundred thousand human heads as the foundation for a great bridge, and that government officers were going about the river in search of heads. A hunting-party, consisting of four Europeans, happening to pass in a boat, were set upon by the hundred and twenty boatmen with the cry, 'Gulla katta,' or cut-throats, and only escaped with their lives after the greatest difficulty. The men were arrested, and thirty-one of them sentenced to terms of from one to three months' imprisonment.

— The demolition of the oldest Jewish quarter in Europe, dating, it is said, from before Caesar's time, is proceeding rapidly. The archeological commission, which is charged with the exploration and protection of ancient monuments, has applied to the Italian government that measures shall be taken for clearing the temple of Jupiter and the portico of Octavia from the buildings which have grown up around them, and also for putting them in such a state of repair as is necessary for their preservation. The commission also requests that the new streets which are to be laid down over the cleared area shall be so planned that their points of intersection shall coincide with the following ancient buildings, which are now within the Ghetto: the theatre of Marcellus, the crypt of the Emperor Balbus, and the porticos of the Flavian emperors and of the Emperor Philip. There is a supplementary request that these buildings shall be placed on the list of ancient monuments, for the preservation of which a small contribution is annually made by the state.

— The African expedition which will leave England in August next, fitted out at the expense of the Royal geographical society, and commanded by Mr. J. T. Last (who, as a lay agent of the Church missionary society, has done admirable work in the Zanzibar interior), after making up its caravan at Zanzibar, will proceed south to Lindi, to the north of the mouth of the Rovuma River. Thence Mr. Last will proceed to the confluence of the Rovuma and Lugende rivers, and fix the longitude of the junction, — an important geographical point not yet settled. He will then go on in a generally south-westerly direction, and, before reaching the north end of Lake Sherwa, turn southwards, and make for the Namulli Hills, which, with other new features in this region, were discovered by Consul O'Neill in the end of 1883. Here Mr. Last will establish himself, and make a detailed study of the whole region in all its aspects. He will make a complete survey of the surrounding country, its topography, people, botany, economic products, climate, and languages. When this is completed, Mr. Last will enter the valley of the Likugu River, which rises in the neighborhood of these hills, and follow it down to the coast at Quizungu, whence he will travel south to Quilimane, or north to Angoche, and thence to Mozambique. Mr. Last will make a special point of collecting all possible information concerning the country he passes through, its changes, its people, their customs, languages, etc., the climate, its sanitary conditions, and its suitability for the introduction of European and other economic plants. The Lukugu valley is said to be very thickly populated, and must therefore be unusually fertile, and so of interest both to the colonist and the trader.

— The fact that sheet-lead in storage-batteries decays very soon, is a serious drawback to its use; and Dr. Kalischer recently described a secondary battery before the Physical society of Berlin, in which iron was used as the anode, and a concentrated solution of nitrate of lead as the electrolyte. The iron, on being immersed in the lead solution, becomes passive, and resists corrosion in the liquid. When a current is sent through the cell, peroxide of lead is deposited on the anode in a firm mass all over it. When nearly all the nitrate of lead is decomposed, there is a greater liberation of gas at the anode. The development of gas is to be avoided at the beginning of the charge: otherwise the peroxide of lead, or, strictly speaking, the hydrated peroxide of lead, becomes covered with bubbles of the gas. A cathode of sheet-lead is employed; but, to prevent it short-circuiting the cell by sending out lead shreds in charging, Dr. Kalischer amalgamates it, — a precaution which also saves the lead from corrosion by the nitric acid left in the cell after separation of the lead. The electromotive force of this cell is about 2 volts to begin with, but after six hours' discharge it falls off to about 1.7 volts. On leaving the cell at rest for twenty-four hours, it is found to recover some of the electromotive force lost. An attempt to substitute sulphate of manganese for nitrate of lead in the battery did not answer the purpose.

— The German New Guinea company, at the head of which stands Herr Adolf von Hausemann, has received an imperial charter dated May 17. The charter covers the following limits: 1. That part of the mainland of New Guinea under neither English nor Dutch supremacy. This district, called by permission Emperor William's Land, stretches from 141° east longitude (Greenwich) to the point near Mitre Rock cut by the 8° south, stretching thence south and west to where this parallel is cut by the 147° east longitude, then in a straight line north-west to where the 6° south latitude crosses 144° east longitude, and farther in a north-westerly direction to where the 5° south latitude crosses the 141° east longitude, then in a straight line north to the sea again. 2. The islands of this part of the coast of New Guinea, also the archipelago hitherto called New Britain, now to be called the Bismarck Archipelago, and all other islands north-east of New Guinea between the equator and the 8° south latitude, and between 141° and 154° east longitude. The company is made responsible, under imperial supervision, for keeping order within these limits, with right of possession, subject to previous agreements, and treaties with the natives.